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VARIATIONS OF GLACIERS. XX[1]

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The following is a summary of the *Nineteenth Annual Report* of the International Committee on Glaciers.[2]

THE REPORT OF GLACIERS FOR 1913

Swiss Alps.—Sixty-one glaciers were measured in 1913; a larger proportion were retreating this year than in 1912. The Rhone Glacier, however, has grown in thickness, throughout, with an increase of velocity and an advance of the tongue.

Eastern Alps.—The summer of 1913, like its predecessor, was very wet, especially on the north side of the Alps; the conditions during both summers must have influenced the glaciers in 1913. Of the 37 glaciers observed 8 were advancing, 4 were stationary, and only 25 continued their retreat. The increase in the number of advancing glaciers is certain, and the retreat of the glaciers of the Eastern Alps has diminished; it is doubtful if the retreat can now be said to be the prevailing condition.

Italian Alps.—In the Piedmont Alps the snowfall has been too heavy to permit of good observations, but the glaciers are apparently retreating. Careful photographic surveys have been made of three of the large glaciers on the south side of the Mount Blanc massif; these glaciers are retreating; but the snowfall in the higher regions has increased, so much so in places as to cause a marked change in the appearance of the mountains. In the Monte Rosa group the observed glaciers were retreating. In the Lombard Alps some glaciers were making slight advances, some slight retreats. On the whole, the large glaciers of the Italian Alps were retreating, but a number of the smaller ones were slightly advancing or were in a doubtful condition.

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[1] Earlier reports appeared in the *Journal of Geology,* Vols. III–XXIII.

[2] *Zeitschrift für Gletscherkunde,* IX (1914), 42–65.

Swedish Alps.—But one glacier, the Mikka, was observed, and it showed no change.

Norwegian Alps.—All the 16 glaciers examined in the Folgefon and the Jostedalsbrae were retreating with one exception. On the other hand, in the Swartisen, the Okstinderne, and the Frostisen, 7 glaciers were advancing, one retreating, and two were stationary.

Russia.—Observations in the Caucasus and in Turkestan have laid the basis for the determination of future changes. One glacier in the Caucasus was retreating and two were stationary.

Canada.—No observations have been recorded in the last two years;[1] but during the few years before 1910 the Illecillewaet, the Asulkan, the Victoria, and the Yoho glaciers were all retreating. Shortly before 1909, however, the Asulkan made an advance.

Himalaya.—The greater part of the information collected refers to variations which occurred some years ago. The positions of the ends of many glaciers were determined in 1906, but later observations are not available. At that date there was evidence that the glaciers were generally retreating.

New Zealand Alps.—Here also observations are scanty. For about ten years after the middle of the nineties, several of the larger glaciers advanced. Later conditions have not been reported.

REPORT ON THE GLACIERS OF THE UNITED STATES FOR 1914

Mr. F. E. Matthes sends me the following information:

> The snowfall during the winter of 1913–14 in the Sierras was so heavy that the glaciers were still completely covered at the end of September; the snow extended even beyond some moraines which encircle the glaciers at a short distance. These moraines are recent; the youngest is comparable to the moraines which marked the advance of the Alpine glaciers at the end of the eighteenth and the beginning of the nineteenth centuries. Historical evidence is not available to determine the actual time when these moraines were formed; but the presence of big trees (*Sequoia Washigtoniana*) near the glaciers may supply the information; for their rings of growth contain a trustworthy record of the climatic fluctuations of the last three thousand years.

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[1] The last report on the Canadian glaciers in this series was in *Variations of Glaciers*, XIII, report for 1906. See *Journal of Geology*, XVI (1908), p. 665.

Professor Lawrence Martin sends me the following information regarding the Alaskan glaciers:

College Fiord.—Miss Keen visited Prince William Sound during the summer of 1914 for the exploration of the Harvard Glacier, and made careful observations of the variations of a number of other glaciers.[1] She found that the Harvard Glacier is 18 miles long, or about 28 miles if the Brunonian Glacier tributary is included. It rises at an elevation of about 7,500 feet. The eastern side of the end of Harvard Glacier seems to have retreated slightly between 1910 and 1914, but the western edge near Radcliffe Glacier was still advancing. There was no observable change in Downer, Baltimore, and Smith glaciers. Bryn Mawr may have retreated slightly; the barren zone at its northern border was widest, but the evidence was conflicting, for a shrub north of the glacier was being overturned at the time of Miss Keen's visit. Vassar Glacier was more crevassed in 1914 than in 1910, but had not advanced appreciably; Wellesley Glacier had retreated slightly; Yale Glacier seems to have advanced a little; Barnard had a slight forward movement.

Harriman Fiord.—The recession of Barry Glacier, observed in 1913, continued in 1914. The total recession of different parts of the ice front, from 1910 to September 25, 1914, was 3,000–7,000 feet. Cascade Glacier was nearly independent of the Barry in 1914. Of the other ice tongues in Harriman Fiord the Baker Glacier advanced at least 1,000 feet between 1910 and 1914, and spread considerably at both borders. The Harriman and Roaring glaciers seem to be still advancing. A small unnamed ice mass on the slopes of Mt. Muir moved forward slightly. The Surprise, Cataract, Serpentine, Toboggan, and Dirty glaciers were unchanged.

Eastern Prince William Sound.—The Valdez Glacier, continuing its long-maintained recession, melted back about 200 feet from 1909 to August 10, 1914. Shoup Glacier advanced very slightly. Columbia Glacier, the largest ice tongue in Prince William Sound, is also the most interesting, for it has continued the slow forward movement that has been in progress since before 1908. Miss Keen found that the eastern border advanced 1,500 feet between 1910 and September 30, 1914, and spread laterally; in other parts the advance was less, being perhaps 1,300 feet on Heather Island. Photographs of Childs Glacier, by Robert Sewall, show that in July, 1914, its northern border was retreating.

Southeastern Alaska.—It was reported in the Juneau papers that Norris Glacier, in Taku Inlet, had made a considerable advance. A photograph of the Taku Glacier, taken about 1907, shows a distinct advance since 1890.

Dr. Martin has tabulated the snowfall and temperature as recorded at several Alaskan stations. He finds not only great differences in different years, but the years of maximum snowfall at the various stations are different, so that it is not safe to draw any detailed conclusions about the snowfall in the mountains from the records at the stations; though the general trends are the same. The annual snowfall at Killisnoo, somewhat more than one hundred miles southeast of Muir Glacier, between 1891 and 1896 was about twice as great as it has been since then; but the glaciers do not show corresponding variations. Temperature records have been kept at Sitka, with two short intermissions, since 1828. The average temperature for the five months from May to September in the years 1828–77 and in the years 1906–13 differs by only one-tenth of a degree Fahrenheit. The average temperature at Juneau for the same months during the years 1906–13 is about 2° F. higher than during the years 1883–96. It does not seem possible to infer any definite relations between temperature and glacier variations from these records.

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[1] *Bulletin of the American Geographical Society*, XLVII (1915), 117–19.

The United States Geological Survey has published a map of a portion of the Chugach Mountains, northeast of Prince William Sound, on a scale of about one inch to the mile (Port Valdez District, Alaska; sheet 602 B). It shows a large area of glaciers and snowfields. Parts of the Columbia, Shoup, and Valdez glaciers appear on it. Unfortunately the contours are not carried over the glaciers, but the altitudes of a number of points are indicated so that marked future changes in the thickness of the ice will be determinable. Other new maps of Alaskan glaciers cover the Haganita-Bremner region, northeast of the Copper River Cañon,[1] the Bering Glacier, and the western border of the Malaspina Glacier at Icy Bay,[2] and part of the Kenai Peninsula.[3] An excellent topographic map, on the one-inch scale, showing all the glaciers and their relations to the mountains and rivers, accompanies M. C. Campbell's *Popular Guide to the Glacier National Park.*[4] Pamphlets containing popular accounts of the glaciers of Mount Rainier and of Glacier National Park have been issued by the Department of the Interior.[5]

[1] *Bull. U.S. Geol. Surv. No. 576,* Plate I.

[2] *Bull. U.S. Geol. Surv. No. 592,* Plate IV.

[3] *Ibid.,* Plate VIII.

[4] *Bull. U.S. Geol. Surv. No. 600.*

[5] *Mount Rainier and Its Glaciers,* by F. E. Matthes; *Glaciers of Glacier National Park,* by W. C. Alden.